

PRELIMINARY PROGRAM
ACS meeting in Los Angeles
Page 59

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CHEMICAL & ENGINEERING

NEWS



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Salary Survey

For chemists, earnings higher
and unemployment low

Page 39

News of the Week

■ The drought in the Midwest is not expected to hurt the agricultural chemical industry this year and may even result in increased demand next year for fertilizer and pesticide products. **Page 4**

■ In an unusual move, *Nature* has published a paper containing research results that the journal's editors and the paper's referees consider unbelievable. **Page 5**

■ Congress probes aftermath of the recent explosion of a rocket solid fuel oxidizer plant in Henderson, Nev. **Page 5**

■ An environmental conference in Toronto recommends an international convention to prevent global warming by minimizing emissions of "greenhouse gases." **Page 6**

■ Bills introduced in the House and Senate would elevate EPA to Cabinet-level status. **Page 6**

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Letters	2
Editor's Page	3
Concentrates	
Business	7
Government	15
Science/Technology	21
The Departments	
New Products	66
Awards	79
Newscrips	92

Business

Union Carbide's claim that sabotage caused 1984 Bhopal disaster is backed by contract firm it hired to investigate accident; more restructuring and explosion of foreign investment are among changes that lie ahead for the U.S. chemical industry; dramatic decline in U.S. petrochemicals exports by 1990 is forecast by Pace Chemicals consultant. **Page 8**

Government

R&D funding levels are up for most federal agencies in fiscal 1989 appropriations bills passed by House. **Page 16**

Technology

Methane may provide alternative source for ethylene; field uses for ion mobility spectrometry debut; new class of polymer electrodes are versatile and stable; fluorescence of new chelating agent is multiplied 1000 times on complexation; Software/database update, a new C&EN feature to appear on a regular basis, provides information on new chemistry-related programs. **Page 22**

Priestley Medal Address

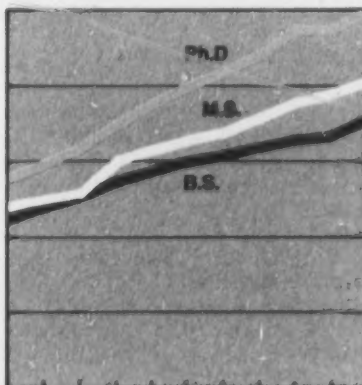
Harvard's Frank H. Westheimer calls for greater emphasis in schools on science and mathematics for nonscientists. **Page 32**

ACS News

Committee on Professional Training reports on 1987 bachelor, master, and Ph.D. graduates of ACS-approved schools; University of California, Berkeley, continues to be top producer of Ph.D. chemists. **Page 49**

Meetings

Preliminary program for ACS national meeting in Los Angeles lists all symposia, includes advance registration form. **Page 59**



Salary Survey

Salaries earned by chemists are up moderately; median salaries this year are 5 to 6% higher than in 1987, the latest ACS survey indicates. Unemployment among chemists, meanwhile, remains at a very low level. **Page 39**

Chemical & Engineering News

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LETTERS

CHEMICAL SAFETY

THF/thionyl chloride explosion

SIR: Recently we experienced an explosion of a 1-gal glass bottle containing approximately a 2:1 mixture of thionyl chloride and tetrahydrofuran (THF). The thionyl chloride had been distilled from a 12-L preparation of an acid chloride. The THF had been added to the distillation to displace the residual thionyl chloride and provide solvent for the succeeding step. Approximately 20 minutes after the THF distillate was poured onto the thionyl chloride, the explosion occurred, completely shattering the bottle.

Extensive thermal studies have been conducted on this system. Results show that an unstirred mixture of THF and thionyl chloride will react violently when heated to about 60 °C, resulting in large temperature and pressure increases. The products of this reaction are bis(4-chlorobutyl) ether, 1,4-dichlorobutane, and SO₂ gas.

We postulate that the explosion was caused by the sudden generation/release of a large volume of SO₂. The energy required to attain the initiation temperature was supplied by a localized change in temperature of about 20 °C when the THF was poured on top of the thionyl chloride. Adiabaticlike conditions in the center of the bottle allowed the solution to slowly self-heat, eventually reaching initiation temperature.

We would like to alert the chemical community to the potential explosivity of certain ratios of THF and thionyl chloride. If such mixtures are to be used, we recommend careful analysis of the hazards.

Randy W. Jackson
Jim Segretario
Mary Cooke
Tim Bryant

Medical Products Dept.
Jackson Laboratory, Du Pont

Motivated by issues

SIR: From time to time I ponder writing, but lack sufficient motivation to respond to issues raised in C&EN. The May 16 issue, however, had three letters that stirred me, and that is too many to let pass.

First, about the "alternative doctorate." Except for a postdoctoral stint at Oak Ridge National Laboratory, all of my post-Ph.D. career has been spent in academia. Both of my appointments have been at small schools that grant only the B.S. and M.S. degrees to chem-

istry majors. We consistently tout what I thought was the party line in order to encourage our students to go on for the Ph.D.: that even with a master's degree in chemistry, employment will be limited to positions only moderately more elevated than those accessible to persons without degrees. We have had personnel directors say this to our students as well. The message is that if they aspire to move up (to group leaders and higher, for instance) and be able to initiate real, original research rather than primarily carry out assigned tasks, the Ph.D. is a virtual necessity. So, my question to David Schyrer is: Do we in academia need to revise our information? Do you estimate that there is a sufficiently significant percentage of non-Ph.D. chemists doing original research to justify the formal recognition you propose? I am not debating the concept of the proposal. Rather, as a chemist educator, I would like to have my story straight regarding what B.S. and M.S. graduates can expect to find in industry.

Second, in response to Mary Keith's letter on loss of ozone: She angrily castigates tennis players who indulge in "the luxury of the rich" and selfishly promote loss of ozone and its accompanying health and environmental problems. I am a college chemistry professor who plays tennis. Even after being awarded the University Research Award I was entitled to only the same paltry 2.4% salary increase as everyone else here. I am not rich, and I am not getting rich. I might, however, be near-sighted. Let me refer Ms. Keith to another letter appearing in the same issue of C&EN on a similar topic. L. Rinehart writes: "I fully agree that the public should be educated to its own responsibility for the environmental effects of technologies it patronizes, but this does not lift the burden from the people who are creating the chemical hazards, and are making money doing so." I will now write to representatives of the U.S. Lawn Tennis Association to express my opposition to the chlorofluorocarbon-containing tennis balls. What will Keith do? Stop living? Why such a sadly narrow view of life?

Finally, to Lorraine D. Rodriques who wrote that when "a predominately male organization pays me the respect of appointing me," she will accept being called a chairman. Yes, Lorraine, the "women's concerns," of which title is only one very small one, is "an old . . . somewhat boring issue." Yes, Lorraine, "There are better things to do with my time" also. But it is dispositions like yours that perpetuate the concerns!

Continued on page 90

1989 R&D Appropriations Higher for Most Federal Agencies

Many units fare well in budget bills, although cuts are planned in defense research, agricultural R&D, and a number of specific line items

Janice R. Long, C&EN Washington

Moving swiftly compared with previous years, the House has passed all of the fiscal 1989 appropriations bills. These bills are the vehicles used to tell federal departments and agencies just how much money they actually have to spend in any given fiscal year.

As set by the House, total federal R&D spending in fiscal 1989 will be down slightly from current levels, primarily because of a 9%, \$3.6 billion, cut in defense R&D spending. Funding for the Strategic Defense Initiative will be held to \$3.2 billion, \$1.3 billion less than the Administration asked for and \$400 million less than is currently being spent on the program.

The House version of the Department of Defense Appropriations Bill, H.R. 4781, also provides \$35 million for high-temperature superconductivity research; \$100 million for SEMATECH, a joint semiconductor manufacturers' research project; and \$95 million for DOD's University Research Initiative. That's an increase of \$10 million over current funding levels.

However, DOD won't be able to spend the university money, at least for a while. The bill states that "the Secretary of Defense shall award the funds made available under this act for the University Research Initiative Program on the basis of competition," and that "none of the funds may be obligated or expended

until the Appropriations and Armed Services Committees of the House and Senate approve a plan submitted by the Secretary of Defense to provide for broader geographic distribution of funds under such program in comparison to the distribution of such funds during fiscal 1986 and 1987."

Funding for the next largest federal R&D funding agency—the National Institutes of Health—is provided in the Departments of Labor, Health & Human Services, and Education and Related Agencies Appropriation Bill, H.R. 4783. Under the provisions of that House-approved spending plan, NIH gets a budget increase of 8%, or \$510 million, to \$6.9 billion.

Funding for NIH's Acquired Immune Deficiency Syndrome research programs is up 26%, or \$120 million, to \$588 million. Funding for the Institute of General Medical Sciences, which funds the lion's share of NIH's academic chemistry research, is up 9% to \$623 million.

The NIH appropriations bill includes \$4.1 million for investigator-initiated research projects. That amount represents an increase of 10% over current funding. However, contrary to its custom in previous years, the Appropriations Committee did not tell NIH how many new projects to fund with the money. The committee said it no longer believes that the number of projects is an accurate measure of the volume of research being supported.

The committee also noted that NIH's 1989 budget request assumes a 13% decrease in the number of new research project grants and a 10% decrease in the number of noncompeting projects. The committee says it found this unacceptable and told the NIH director to

try to address the problem while still maintaining the total number of projects above the 1988 level in 1989.

The biggest R&D program increase allowed by the House, 28%, is for the National Aeronautics & Space Administration, which gets approximately \$4 billion in the Department of Housing & Urban Development-Independent Agencies Appropriations Bill, H.R. 4800. Despite the large increase, NASA's total R&D budget is still \$280 million less than the Administration wanted.

The Appropriations Subcommittee on HUD-Independent Agencies was told fairly late in the budget process that because of scorekeeping adjustments agreed to in the 1989 budget resolution, its budget allocation had to be reduced \$439 million. So the subcommittee had to go back to the drawing board.

It had originally allocated \$902.4 million for the space station. But because of the new budget constraints it decided to defer funding of \$450 million of space station funds. Those monies will now become available only if the next President submits a special message to Congress indicating that he intends to proceed with the use of the money and the development of the space station program. If the message is not received by April 15, 1989, the program will be terminated. Meanwhile, NASA will have about \$60 million per month to spend on the space station program in the first six and one half months of fiscal 1989.

Funding for the Department of Energy's R&D programs is up 3% to \$3.9 billion. However, funding to support research and technical analysis is down 6% to \$610 million. Within that category, funding for

House votes to trim federal R&D funding

\$ millions	1988		1989	% change	
	Appropriation	Request		Appropriation vs. request	Appropriation vs. 1988
Defense	\$35,844.8	\$38,157.1	\$38,283.2	-7%	-9%
Tactical programs	12,945.7	13,092.7	12,211.7	-1	8
Strategic programs	6,046.7	6,524.8	7,390.7	-7	-18
Advanced technology development	5,072.3	6,507.3	5,433.7	-22	-7
Intelligence & communications	4,478.6	4,409.8	4,882.2	0	-8
Defensewide mission support	3,825.5	4,285.4	4,051.2	-11	-6
Technology base	3,275.7	3,277.3	3,293.7	0	-1
NIH	6,882.5	6,802.1	6,382.3	1	8
NASA R&D	4,166.7	4,446.7	3,274.2	-8	28
Energy	3,941.4	3,725.0	3,835.6	6	3
Energy supply R&D	1,761.3	1,805.9	1,816.3	-2	-3
Supporting research & technical analysis	610.5	611.8	646.5	0	-6
Fusion	343.0	360.0	335.0	-5	2
Environment	327.0	359.0	336.2	-9	-3
Nuclear	323.2	351.9	347.0	-8	-7
Renewable resources	157.6	123.2	147.6	28	7
Weapons R&D	969.4	964.4	959.5	1	1
General science and research	737.9	706.9	635.4	4	16
Fossil energy R&D	357.4	167.0	327.0	114	9
Conservation R&D	115.4	80.8	97.4	43	18
NSF	1,885.0	2,050.0	1,717.0	-8	10
Research & related activities	1,578.0	1,603.0	1,453.0	-2	9
Science education	171.0	156.0	139.2	10	23
Antarctic program	136.0	141.0	124.8	-4	9
Science & technology centers	—	150.0	—	—	—
Commerce	1,326.7	1,222.4	1,254.8	9	1
NOAA	1,181.9	1,064.4	1,110.0	11	16
NBS	144.8	158.0	144.8	-8	0
Agriculture	992.8	958.8	1,037.7	4	-4
Agricultural Research Service	566.6	572.0	596.5	-1	-5
Cooperative State Research Service	284.3	257.5	303.7	10	-6
Forest Research	139.9	129.3	135.5	8	3
EPA R&D	367.2	374.8	382.2	-2	4
TOTAL	\$55,211.8	\$57,736.9	\$57,087.0	-4	-3

Note: All numbers are estimates. Source: Congressional documents

chemical sciences operating expenses is up 3% to \$135 million, but funding for materials sciences is up a bare 1% to \$174 million. Funding for DOE's university research support programs is up 40% to \$425.8 million. However, funding for university research instrumentation is held constant at \$6 million.

The House provided only \$100 million of the \$363 million that the Administration had requested for the Superconducting Super Collider in the belief that construction should

not be initiated until the new Administration has had an opportunity to evaluate the project.

The budget constraints on the HUD subcommittee took their toll on the National Science Foundation's budget, which is also funded under H.R. 4800. The bill provides \$1.6 billion for NSF's research and related activities, an increase of 9% over current funding levels, and \$171 million for science education, an increase of 23%. That's not too bad, especially when it's compared with

what NSF was seeking or might have had.

The HUD subcommittee decided not to provide the five-year, \$150 million appropriation NSF had requested to fund its new science and technology centers program. It also did not provide money to fund the \$85 million academic research facilities renovation program provided for in NSF's fiscal 1989 authorization bill. Both of these actions were later endorsed by the full Appropriations Committee and later the House.

At the Department of Commerce, funding for the National Oceanic & Atmospheric Administration is up 16% to \$1.2 billion, whereas funding for the National Bureau of Standards, as provided by the Appropriations Committee, would be essentially frozen at the fiscal 1988 level of \$145 million. NBS money wasn't actually in the Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriation Bill, H.R. 4782, because its fiscal 1989 authorization bill hadn't been approved before the appropriations bill was acted on.

The Department of Agriculture has the only civilian R&D program that is being cut. It's down 4% to \$993 million, primarily because the building and facilities budget for the Agricultural Research Service, which is set at \$58 million this year, was cut to \$11 million in fiscal 1989.

Other recommendations in the department's appropriations bill include a big rise in funding for the Cooperative State Research Service, which includes increases in funding for groundwater quality research and for the 1890 land grant colleges. The bill does, however, cut the service's competitive grants program, leaving just \$29.4 million, a \$12.9 million reduction.

The House action, of course, is just the first step in the appropriations process. The Senate must also act on the bills. But if the appropriations bills already reported for floor action in the Senate are any indication, the final R&D budget for fiscal 1989 will be higher, not lower, than what the House has allowed. □

Chemists' Salaries Rise As Unemployment Stays Low

Median salaries for chemists are up about 5 to 6% this year, in line with the trend during the past decade and slightly ahead of the increase in living costs during the past year

The economic status of U.S. chemists remains basically strong this year, according to the most recent survey, conducted this past spring, of members of the American Chemical Society. Unemployment among chemists remains at a very low level—merely 1.0% of ACS members were unemployed and looking for work as of last March—for the second year running. And the salaries earned by chemists this year are comfortably higher than a year earlier.

The median salaries of chemists (the median is the salary that is exceeded by 50% of the respondents to the ACS survey), as of March 1, are 5 to 6% above those earned a year earlier, the survey indicates. This increase is a considerable improvement from that indicated by the similar survey done last year, when median salaries for chemists whose highest degree is a B.S. or M.S. were up only slightly and the median for chemists with a Ph.D. showed no change at all. This year's

rise in salaries is about in line with the annual increase in median salaries during the past decade or so.

With inflation having been relatively contained during the past year—the Department of Labor's consumer price index rose only about 4% between March 1987 and March 1988—chemists have moderately improved their income relative to living costs, after having lost ground a bit last year. After adjustment for the cost of living, in fact, salaries have largely made up last

Few ACS members, whatever their status or degree, are involuntarily without a job

Employment status ^a	Total	By sex		By highest degree			By minority status		Chemical engineers	All members ^c
		Men	Women	B.S.	M.S.	Ph.D.	Minority ^b	Nonminority		
Employed full time	94.3%	95.2%	91.0%	95.4%	95.6%	93.5%	91.8%	94.5%	94.7%	94.3%
Employed part time	1.6	1.1	3.6	1.5	2.2	1.4	1.3	1.6	1.7	1.6
Postdoctoral or fellowship	2.0	1.8	2.5	0.2	0.1	3.2	5.0	1.7	0.6	1.8
Unemployed										
Seeking employment	1.0	0.9	1.4	1.1	0.9	1.0	1.2	1.0	1.3	1.1
Not seeking employment	1.1	1.0	1.6	1.9	1.1	0.8	0.6	1.2	1.7	1.2

^a As of March 1, 1988. ^b Black, Hispanic, American Indian, Alaskan native, Asian, Pacific Islander, or other. ^c Includes ACS members whose highest degree and present work are in neither chemistry nor chemical engineering. Source: ACS survey

Chemists' salaries rose in past year at about the same rate as for the past decade

\$ Thousands	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	Annual change		
												1987-88	1983-88	1978-88
CHEMISTS' MEDIAN SALARIES ^a														
B.S.	\$35.4	\$33.5	\$33.0	\$32.0	\$30.9	\$30.0	\$28.5	\$27.5	\$25.0	\$23.5	\$22.0	6%	3%	5%
M.S.	41.0	39.0	37.9	36.0	34.0	33.0	31.6	30.0	26.0	25.0	24.0	5	4	6
Ph.D.	50.0	47.7	47.8	44.0	42.0	40.0	37.5	35.0	31.2	29.0	27.4	5	5	6
All chemists	45.0	42.5	42.5	40.0	38.0	36.0	34.7	32.0	28.9	na	na	6	5	na

^a Base annual salary as of March 1, 1988. na = not available. Source: ACS survey

Growth in salaries tends to slow for chemists as they become more experienced

Years since B.S. degree	Median salary (\$ thousands) ^a										Overall
	0 to 1	2 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 or more	
NONACADEMIC CHEMISTS											
B.S.											
90%	\$29.6	\$33.0	\$40.0	\$51.0	\$55.7	\$60.0	\$74.0	\$76.1	\$ 75.0	\$ 83.0	\$56.0
75%	26.1	29.8	35.1	44.0	50.0	52.0	57.0	60.0	62.2	66.4	46.6
50%	24.0	26.0	30.5	37.5	41.4	45.3	45.7	50.0	51.5	51.8	36.0
25%	21.5	22.6	26.7	31.0	34.2	39.0	37.0	41.6	43.8	40.0	28.0
10%	18.7	19.4	24.0	26.0	30.0	29.5	30.0	32.9	35.5	32.0	24.0
M.S.											
90%	—	36.0	41.0	50.6	60.0	66.3	70.0	85.4	80.0	100.0	66.1
75%	—	33.1	37.1	44.8	50.0	53.7	61.5	66.4	68.0	70.0	52.8
50%	—	30.0	32.1	39.6	42.0	46.3	50.8	53.6	56.0	58.0	42.0
25%	—	27.2	27.4	34.0	35.5	39.2	43.7	41.8	48.0	51.4	34.3
10%	—	24.5	24.5	29.0	30.4	32.0	35.0	30.0	41.7	45.2	28.0
Ph.D.											
90%	—	—	48.0	56.0	66.6	80.0	88.0	97.0	100.0	107.0	80.0
75%	—	—	45.0	52.0	60.0	68.0	73.0	78.0	80.5	80.0	66.0
50%	—	—	42.0	47.5	52.8	59.0	63.2	65.0	64.0	67.5	54.8
25%	—	—	40.0	43.0	46.0	50.0	54.5	53.0	54.0	54.0	45.0
10%	—	—	36.6	39.6	40.0	42.5	45.0	45.0	44.5	40.0	40.0

^a As of March 1, 1988. How to read this table: Using, as an example, nonacademic B.S. chemists two to four years after having received their B.S. degree, 90% of these chemists have annual base salaries of \$33,000 or less, 75% have annual base salaries of \$29,800 or less, 50% have annual base salaries of \$26,000 or less, 25% have annual base salaries of \$22,600 or less, and 10% have annual base salaries of \$19,400 or less, as of March 1, 1988. Source: ACS survey

year's small decline. Even so, the median salary for chemists with no more than a B.S. degree, in constant dollars, remains well below the level a decade ago. For those with an M.S. degree, it is lower, also, although not so markedly. For those with a Ph.D., on the other hand, the median, after adjustment for cost of living increases, is about at the same level as 10 years earlier, after having recovered so far during the 1980s from the steep descent that occurred during the late 1970s.

The median salary for all chemists, of course, is a very broad measure. Even when broken down in terms of highest degree earned, it is a relatively poor indicator of what individual chemists are earning or how their salaries compare with those of their peers and colleagues. More meaningful and useful insights require a look at the data in greater detail. In addition to level of education, for example, salaries tend to be dependent on such factors as length of experience, the type

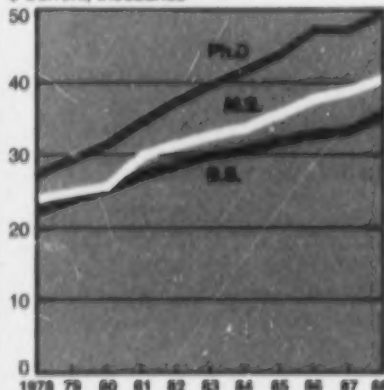
of employer chemists work for, and the type of work they do. That is why the accompanying tables are so detailed.

One bit of information that shows up in such a more focused look is that, as in the past, women chemists continue in general to lag behind their male compatriots in earnings. Because the average age and length of experience of women chemists, as a group, is lower than that for men, the median salary for women would be expected to be lower. But even when a statistical adjustment is made in women's salaries to compensate for this difference, men chemists still have a distinct earnings advantage. (To make this adjustment for differences in experience, the mean salary for men and women must be used for comparison, rather than the median salary.)

The gap—with the average salary for women typically running between 80 and 90% that for men—does not seem to have narrowed appreciably in recent years, moreover. Thus, this year the adjusted mean salary for women chemists with a Ph.D. who are working in industry is 88% that of the mean salary for Ph.D. men with an industrial job; five years ago, the adjust-

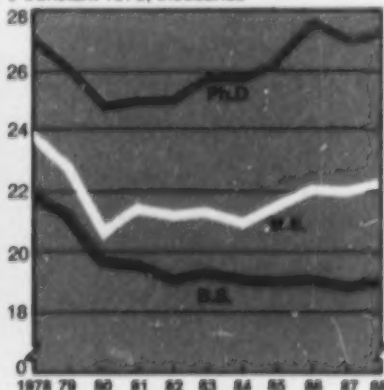
All chemists' salaries have been rising steadily . . .

\$ Current, thousands^a



. . . but only Ph.D.s have done well relative to inflation

\$ Constant 1978, thousands^a



^a Median base annual salary for chemists employed full time as of March 1 of each year. Source: ACS survey

ed mean for women was 86% that for men—no appreciable difference. Similarly, for Ph.D. chemists in the academic world, the adjusted mean for women this year is 82% that for men, little changed from the 84% of five years ago. A bit of a shift toward greater equality between salaries for men and women seems evident, however, in the case of chemists whose highest degree is a B.S. The adjusted mean for such women is 92% of the mean for men for chemists employed in industry and 95% of that for men for those with government jobs. Previous surveys had never shown the mean for women's salaries closer than 88% to that for men in industry or 91% in government in the case of B.S. chemists.

Typically, though, the difference between salaries earned by women and those for men is smallest for younger and less experienced chemists—those who have been awarded their B.S. degree less than 10 years ago. In fact, for industrial chemists the median salary of women with a graduate degree and who earned their bachelor's degree five to nine

Oil refiners and chemical producers pay highest salaries

Industry	% of industrial chemists				Mean salary (\$ thousands) ^a		
	All chemists	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
Pharmaceuticals ^b	16%	15%	19%	16%	\$37.0	\$44.9	\$62.6
Specialty chemicals	15	15	13	15	39.5	45.9	58.8
Basic chemicals	7	4	5	9	43.7	48.9	62.8
Plastics	5	4	6	6	40.7	45.0	62.1
Petroleum and natural gas	4	4	3	4	42.2	50.8	64.5
Coatings	4	6	5	2	38.2	46.0	51.5
Electronics	4	3	3	4	41.0	47.6	62.5
Food	4	4	4	3	40.3	47.4	59.7
Agricultural chemicals	4	3	3	5	39.9	44.1	61.8
Metals and minerals	2	2	2	1	36.0	39.4	53.2
Rubber	2	2	1	1	40.8	40.9	56.6
Soaps and detergents	1	1	1	2	40.3	44.7	61.1
Paper	1	1	2	1	38.0	41.3	56.7
Other manufacturing	18	19	18	18	40.0	49.1	58.9
Nonmanufacturing	12	15	13	9	36.2	46.5	57.1

^a As of March 1, 1988; to facilitate comparison, mean salaries are adjusted for differences in average length of experience for each group. ^b Includes personal care products. Source: ACS survey

years ago actually is slightly higher than that for their male counterparts, the ACS survey indicates.

However, among more experienced chemists in industry, men have a clear-cut salary advantage. Thus the median salary for men working in industry with a B.S. earned between 15 and 24 years ago

is roughly 20% higher than that for similar women. This pattern is similar to that found in previous ACS salary surveys.

Other factors affecting the size of salaries this year also are similar to those found in earlier surveys. For example, salaries understandably increase with increasing experience.

Attaining rank of full professor improves an academic chemist's earnings markedly

Years since B.S. degree	Median salary (\$ thousands) ^a								Overall
	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 or more	
Ph.D. CHEMISTS EMPLOYED FULL TIME IN ACADEMIA									
Ph.D.-granting schools									
Professor	—	—	\$59.2	\$56.1	\$65.9	\$61.0	\$64.0	\$76.9	\$63.4
Associate professor	—	(\$43.9)	43.9	44.8	48.8	(48.8)	(41.5)	—	44.6
Assistant professor	\$35.5	37.9	(37.4)	—	—	—	—	—	37.0
All ranks ^b	31.1	36.9	43.4	50.0	56.8	58.0	62.2	75.0	50.8
Non-Ph.D.-granting schools									
Professor	—	—	(39.0)	46.6	51.2	52.5	55.0	54.4	51.2
Associate professor	—	(35.9)	37.8	40.6	42.7	43.4	(51.0)	(49.6)	41.1
Assistant professor	29.5	33.8	32.9	29.3	—	—	—	—	32.7
All ranks ^b	29.3	33.5	35.4	42.9	48.3	50.9	54.9	52.6	44.0

Note: Where no salary data are shown, sample is too small to provide a meaningful figure; data in parentheses are from relatively small samples, as well, and should be viewed with caution. ^a Base annual salary as of March 1, 1988, excluding summer teaching and other supplemental earnings; salaries of the approximately 50% of academic chemists who have nine- or 10-month contracts are adjusted to a 12-month basis. ^b Includes instructors, lecturers, research associates, and others not listed separately. Source: ACS survey

Women's salaries most closely match those for men among B.S. chemists

Mean salary, \$ thousands ^a	B.S.				M.S.				Ph.D.			
	All chemists	Men	Women	Women as % of men	All chemists	Men	Women	Women as % of men	All chemists	Men	Women	Women as % of men
EMPLOYER												
Private industry	\$39.9	\$42.6	\$39.0	92%	\$45.9	\$46.0	\$39.7	83%	\$58.9	\$59.9	\$52.6	88%
Academic	25.2	27.3	27.1	99	33.2	34.6	30.7	89	43.6	44.7	36.9	82
Government	35.6	36.1	34.3	95	41.2	41.8	35.4	85	51.4	52.3	44.9	86
Other	37.1	39.5	30.2	77	54.3	56.5	39.6	68	57.8	59.4	49.7	84

^a As of March 1, 1988; to facilitate comparison, women's salaries are adjusted for the difference in average length of experience between them and men. Source: ACS survey

For industrial chemists, salaries are highest for work in management

Years since B.S. degree		Median salary (\$ thousands) ^a											Overall
		0 to 1	2 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 or more		
CHEMISTS EMPLOYED FULL TIME IN INDUSTRY													
Sex													
Men	B.S.	\$24.5	\$27.0	\$32.0	\$39.2	\$43.0	\$48.0	\$48.0	\$51.0	\$54.8	\$52.5	\$39.9	
	M.S.	—	(31.6)	32.1	40.0	42.9	48.9	53.0	60.0	58.0	58.0	45.0	
	Ph.D.	—	—	42.0	48.0	53.0	60.0	65.4	68.0	70.0	68.0	56.0	
Women	B.S.	24.0	26.0	29.8	35.0	35.0	40.8	49.7	(42.5)	—	—	30.0	
	M.S.	—	(29.0)	33.0	37.0	39.5	44.5	(45.0)	—	—	—	36.0	
	Ph.D.	—	—	42.5	46.0	51.0	(48.8)	(57.5)	—	—	—	45.5	
Work function													
General management	B.S.	—	(32.0)	37.4	40.0	50.0	(55.0)	(49.8)	(53.0)	65.4	(71.6)	45.4	
	M.S.	—	—	(30.5)	(46.5)	57.0	(52.8)	(70.0)	(60.5)	(67.2)	(70.0)	56.5	
	Ph.D.	—	—	—	(56.8)	60.0	61.7	70.0	90.0	(77.5)	(82.1)	68.7	
R&D management	B.S.	—	—	(38.5)	45.6	(50.8)	(50.5)	(67.5)	(60.1)	63.3	(54.0)	51.9	
	M.S.	—	—	(38.0)	(45.0)	(46.0)	60.0	65.4	(67.2)	(61.5)	—	57.0	
	Ph.D.	—	—	(43.3)	54.0	59.0	69.0	75.0	78.8	81.0	80.0	67.9	
Basic research	B.S.	—	27.6	29.5	(33.0)	—	(46.0)	—	—	—	—	30.0	
	M.S.	—	—	28.7	36.4	(38.1)	(44.0)	—	(55.5)	—	—	36.8	
	Ph.D.	—	—	42.8	48.0	49.8	58.0	59.0	68.0	—	(68.6)	50.7	
Applied research ^b	B.S.	25.0	27.1	30.5	39.1	44.0	43.8	42.3	51.0	46.9	(49.8)	35.4	
	M.S.	—	(30.8)	33.0	39.6	41.0	49.0	49.5	59.0	53.5	—	40.8	
	Ph.D.	—	—	42.0	47.0	51.7	55.3	63.6	61.0	62.0	65.0	50.2	
Production ^c	B.S.	(21.1)	26.0	30.8	34.0	40.9	45.3	45.0	(44.7)	(39.0)	—	33.0	
	M.S.	—	—	27.8	36.8	36.0	42.9	(41.6)	(52.6)	—	—	36.0	
	Ph.D.	—	—	—	(43.0)	(50.3)	(52.8)	(62.0)	—	—	—	51.7	
Marketing ^d	B.S.	—	(30.0)	31.9	45.8	(48.0)	(50.0)	57.5	(55.5)	(50.1)	—	42.0	
	M.S.	—	—	(35.4)	40.0	53.3	(45.0)	(52.5)	(52.0)	(52.5)	—	47.6	
	Ph.D.	—	—	—	(47.0)	(55.0)	58.0	(64.0)	—	(58.1)	—	57.5	
Work specialty													
Agricultural and food chemistry	B.S.	—	—	(26.3)	(36.6)	—	—	—	—	(53.8)	—	40.6	
	M.S.	—	—	(35.0)	(38.8)	(41.0)	—	(51.9)	—	—	—	37.5	
	Ph.D.	—	—	(42.0)	42.4	51.0	58.2	65.7	(61.0)	(89.0)	—	52.1	
Analytical chemistry	B.S.	(24.9)	27.0	30.6	35.6	38.6	45.8	44.6	45.4	(39.0)	—	34.0	
	M.S.	—	(30.6)	33.2	40.0	39.4	44.4	52.0	(45.0)	(53.0)	—	40.0	
	Ph.D.	—	—	42.2	47.5	52.5	59.0	63.0	60.0	60.0	(52.0)	51.6	
Biochemistry	B.S.	—	(25.6)	(34.0)	(38.0)	—	—	—	—	—	—	33.2	
	M.S.	—	—	(28.0)	(44.0)	—	—	—	—	—	—	42.0	
	Ph.D.	—	—	(41.8)	48.0	56.7	56.2	55.0	(73.0)	—	—	53.3	
Environmental chemistry	B.S.	(20.9)	24.0	32.0	38.4	39.0	(42.0)	—	—	(55.5)	—	32.3	
	M.S.	—	—	(27.8)	(40.0)	(49.4)	—	—	—	(52.5)	—	41.0	
	Ph.D.	—	—	—	(53.3)	(54.1)	(55.2)	(52.0)	(65.0)	(80.0)	—	56.0	
Inorganic chemistry	B.S.	—	—	(32.0)	(36.5)	—	—	—	(53.6)	—	—	36.2	
	M.S.	—	—	—	(43.0)	—	—	—	—	—	—	41.0	
	Ph.D.	—	—	(42.0)	48.0	(51.3)	(62.0)	(71.0)	—	—	—	51.6	
Materials science	B.S.	—	(22.7)	30.0	39.2	—	—	—	(52.8)	(52.0)	—	41.0	
	M.S.	—	—	(35.9)	(41.5)	(55.5)	—	—	—	—	—	45.8	
	Ph.D.	—	—	(44.6)	50.0	(53.3)	59.4	70.8	64.3	(62.3)	(59.0)	59.6	
Medicinal and pharmaceutical chemistry	B.S.	—	(27.0)	30.0	(33.8)	—	—	—	(50.5)	(63.3)	—	32.5	
	M.S.	—	—	32.1	38.0	(41.0)	(46.8)	—	—	—	—	38.5	
	Ph.D.	—	—	42.6	47.4	55.0	60.2	73.0	(63.2)	(81.5)	(78.0)	55.0	
Organic chemistry	B.S.	—	27.4	30.0	40.4	(46.0)	(43.6)	(45.5)	(54.4)	(56.1)	—	36.5	
	M.S.	—	—	—	34.8	(37.9)	(48.0)	—	(55.5)	(59.0)	—	42.0	
	Ph.D.	—	—	41.8	47.5	52.5	60.0	65.5	65.0	63.0	(82.0)	54.0	
Physical chemistry	B.S.	—	—	—	—	—	—	—	—	—	—	(38.0)	
	M.S.	—	—	—	—	—	—	—	—	—	—	48.6	
	Ph.D.	—	—	(42.8)	50.0	56.8	57.0	65.0	(76.5)	(66.0)	—	55.1	
Polymer chemistry	B.S.	(26.1)	28.0	32.5	42.2	52.5	50.0	50.3	49.0	48.0	(63.4)	42.0	
	M.S.	—	—	32.1	40.0	44.0	48.0	(62.2)	(59.6)	58.0	—	47.2	
	Ph.D.	—	—	42.0	48.6	53.0	64.1	65.5	69.8	69.3	67.3	55.5	

Note: Where no salary data are shown, sample is too small to provide a meaningful figure; data in parentheses are from relatively small samples, as well, and should be viewed with caution. ^a As of March 1, 1988. ^b Includes development and design. ^c Includes quality control. ^d Includes purchasing, technical service, and economic evaluation. Source: ACS survey

Unemployment remains at a low level for chemists this year

Employment status ^a	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978
Employed full time	95.4%	95.4%	94.6%	95.2%	93.7%	93.5%	94.9%	95.6%	95.9%	95.0%	95.7%
Employed part time	1.6	1.5	1.5	1.5	1.7	1.7	1.4	1.1	1.0	2.0	1.0
Postdoctoral or fellowship	2.0	2.0	2.0	1.9	2.9	2.6	2.2	2.2	2.2	1.9	1.9
Unemployed	1.0	1.1	1.7	1.4	1.7	2.2	1.5	1.1	0.9	1.1	1.4

^a As of March 1, 1988; excludes chemists who are not employed but not seeking employment. Source: ACS survey

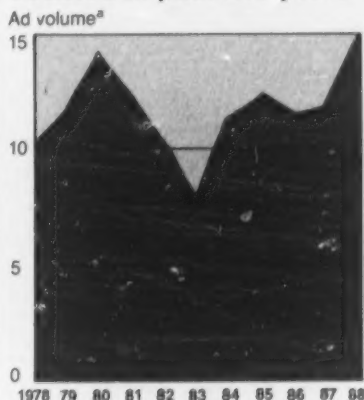
But the median salary of chemists, as they progress through their career, increases much more rapidly early on than in the later stages. The median for B.S. chemists who obtained their degree 20 to 24 years ago and who are not working for a college or university, for instance, is nearly double that for similar chemists who graduated only in the past year. But it rises only 14% further for chemists with 40 or more years of work experience.

This year, as was also typical in the past, chemists working for industrial firms tend to have higher salaries than those employed by government agencies, in academic institutions, or working for other types of employers. And within industry, the highest median salaries are for chemists working for petroleum companies and producers of basic chemicals—although for Ph.D. chemists, at least, companies making pharmaceuticals, electronic equipment, and plastics also rank high. Lowest salaries, on the other hand, are paid by industries in which relatively few chemists find work, such as those producing metals, paper, rubber, and coatings. Salaries are relatively low, also, with companies outside the manufacturing industries.

Among industrial chemists, too, salaries not surprisingly tend to be highest for those working in managerial positions. One reason that women's salaries, even after they are adjusted for differences in length of experience, tend to be lower than those for men is that disproportionately fewer women hold managerial positions.

Among chemists in academia, salaries are clearly higher for those teaching in schools that have Ph.D. programs than in those that don't. Although the ACS survey indicates that salaries paid by colleges and universities are appreciably lower

Volume of help-wanted ads doubled in past five years



^a Volume of help-wanted advertising (in thousands of column inches) in C&EN for the 12 months ending with June of each year.

than those earned by chemists who work for other types of employers, it should be noted that the survey results reported here are for the base annual salary from the employee's principal job; they do not include earnings from summer teaching or consulting fees, as well as funds obtained from grants or fellowships.

The unemployment rate last March of 1.0% among chemists who are ACS members is about as low as that figure has been since ACS began surveying the employment status of its members in 1971. And although unemployment is somewhat higher for women than men and for chemists who do not have a graduate degree than for those who do, it is essentially at a historically low level for chemists of any type. It is low, too, no matter what type of work an individual has been involved with or where he or she may have been employed. The unemployment rate for chemists is similar to the rate of 1.2% last March for all professional workers in the U.S. labor force.

Joblessness is low for all types of chemists

	% of chemists	% unemployed in category played ^a
MOST RECENT EMPLOYER		
Industry	62%	1.0%
Academic	23	0.5
Government	9	1.2
Other	6	2.2
MOST RECENT WORK FUNCTION		
R&D	43%	1.2%
Teaching	13	0.5
R&D management	12	0.8
General management	9	0.8
Marketing ^b	7	1.2
Production ^c	5	0.8
Other	11	1.7
MOST RECENT WORK SPECIALTY		
Analytical	20%	1.0%
Organic	13	0.7
Polymer	12	0.9
Biochemistry	9	0.7
Environmental	8	1.6
Physical	7	1.3
Medicinal ^d	6	0.4
Inorganic	5	1.1
Agricultural and food	4	1.1
Other chemistry	16	1.0

^a As of March 1, 1988; excludes chemists who are not employed but not seeking employment. ^b Includes purchasing, technical service, and economic evaluation. ^c Includes quality control. ^d Includes pharmaceutical and clinical chemistry. Source: ACS survey

About 3% of the chemists responding to the ACS survey report that they were without work sometime during 1987. This is a slightly lower level of unemployment than indicated by the survey conducted a year earlier (C&EN, Aug. 10, 1987, page 28). As was the case in 1986, women were nearly twice as likely than men to have been unemployed at one time or other last year, and chemists with no more than a B.S. were more frequently jobless than those who have earned a graduate degree.

Most of those who were jobless and seeking work in 1987 were not

Chemists most often learned about their present job through personal contacts

Source of information about current job	Total	By sex		By highest degree			By present employer			
		Men	Women	B.S.	M.S.	Ph.D.	Industry	Academic	Government	Other
Personal contact or employee referral	45%	45%	43%	41%	42%	48%	41%	54%	54%	43%
Campus recruiting or placement office	13	13	12	11	12	14	17	4	8	7
Newspaper advertisement	12	10	20	22	16	6	14	6	8	9
ACS services	8	9	5	3	8	12	6	18	5	7
Private employment agency	7	7	5	10	8	4	10	a	1	2
Services of other professional organizations	2	2	2	1	2	2	2	3	2	3
Government employment service	2	2	2	3	2	1	1	a	11	0
Other	12	12	12	9	13	13	9	15	11	29

a Less than 0.5%. Source: ACS survey

Few chemists were jobless more than six months last year

Months unemployed during 1987	Less than 1	1 to 3	4 to 6	7 to 12
All chemists	15%	44%	25%	16%
Men	18	45	21	16
Women	12	60	23	5
Highest degree				
B.S.	19	54	23	4
M.S.	16	47	17	20
Ph.D.	14	46	22	18

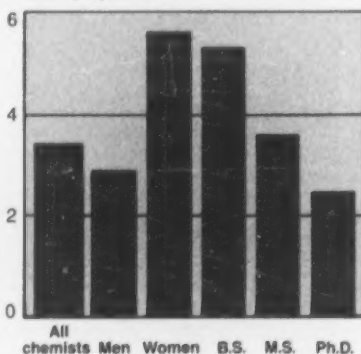
Note: Excludes chemists not in the labor force March 1, 1988.
Source: ACS survey

unemployed long; 59% were out of work for only three months or less. Only 16% were without a job for more than six months. Chemists with graduate degrees, however, seem to take more time in finding suitable work. For example, 73% of B.S. chemists but only 60% of Ph.D.s were unemployed for three months or less. On the other hand, 18% of the Ph.D.s were six months or more without work, compared with just 4% among B.S. chemists who were out of work that long.

Strength in the job market for chemists also is apparent in the volume of employment advertising published recently in C&EN, which carries more such advertising aimed at chemists than any other publication in the U.S. Last year, C&EN's volume of classified advertising by employers totaled about 13,000 column inches, up 15% from 1986 and more than for any year since 1980. In fact, 60% more help-wanted advertising ran in C&EN last year than

About 3% of chemists were jobless sometime in 1987

% unemployed^a



a Excludes chemists who were not employed but not seeking employment. Source: ACS survey

in 1982. And the volume has continued to rise significantly this year. For the 12 months through June, the total has climbed to 15,000 column inches, nearly 30% more than in the 12 months through June 1987. This is strong evidence that demand for chemists is greater now than at any time in the recent past.

For the first time this year, the annual economic survey of ACS members asked respondents, "How did you find out about your current job?" The most frequent source of such information by far is through personal contact or employee referral; 45% of chemists found their job that way. Running far behind as avenues to employment are campus recruiting or college placement offices, the means used by 13% of chemists to find work, and classi-

fied advertising in newspapers, which provided jobs to 12%.

ACS services, such as ads placed in C&EN or registration with the ACS employment clearinghouse, served 8%. These ACS services are much more likely to be used by Ph.D. chemists, 12% of whom found employment that way, than by B.S. chemists, only 3% of whom got their job with the help of ACS. Chemists who work in academia also are more likely to get work through ACS services—18% did so—than those who work for other employers. B.S. chemists, on the other hand, are much more likely to obtain jobs through answering newspaper ads than are chemists with a graduate degree. Women, too, are twice as likely as men to find jobs from newspaper ads.

Information on the current salaries and employment status of ACS members is based on nearly 12,000 responses to a mail survey of a random sample of members conducted this past March by the ACS Marketing & Business Analysis Department for the Member & Professional Services Department. The survey was limited to members who have U.S. mailing addresses, are not students, retired, or emeritus members, and who are less than 70 years of age.

More detailed results from this year's ACS survey are available in the report, "Salaries 1988," which can be purchased from the ACS Distribution Office, Room 210, American Chemical Society, 1155—16th St., N.W., Washington, D.C. 20036. The price of this report is \$150. □

ACS Committee on Professional Training 1987 Annual Report

The number of bachelor's degree graduates in chemistry from colleges and universities whose undergraduate chemistry programs are approved by the American Chemical Society decreased 5.2% in the 1986-87 academic year from the previous year. The number of master's degrees from these departments rose 1% and the number of Ph.D. degrees continued to rise for the eighth year in a row, this year by 2.6%. These departments project that in 1988 bachelor's degrees will increase 3%, master's will increase 18%, and Ph.D. degrees will increase 14%. (It should be noted, however, that these projections are usually higher than actual counts a year later.)

The percentage of baccalaureate graduates certified to ACS was 41%, slightly less than last year. (Certified graduates are those who have completed the curriculum specified by the Committee on Professional Training (CPT) and are eligible for full membership in ACS; noncertified graduates may become associate members of ACS upon graduation, full members after three years of professional experience or a higher degree in a chemical science.)

A total of 2269 of the bachelor's degree graduates from the approved schools were reported as planning to go to graduate school, and 1874 reported plans to go to professional schools.

Total numbers of bachelor's degrees (certified and noncertified), master's degrees, and Ph.D. degrees awarded in 1986-87 by departments whose chemistry programs are ACS approved are listed by institution in the large table at the end of this report and are summarized in the two smaller tables. These tables also include numbers of chemical engineering graduates from institutions

whose programs are accredited by the American Institute of Chemical Engineers and the Accreditation Board for Engineering & Technology. (These departments are not required to report their data to CPT, so the number of departments included varies each year.)

The number of bachelor's degrees in chemical engineering from the 107 AIChE-ABET-accredited departments that reported in 1987 decreased 18% from the total reported by 118 departments in 1986, the fourth decrease in a row. These 107 departments reported an expected further decrease in bachelor's degrees of 10.5% in 1988. At the graduate level, the number of chemical engineering master's degrees decreased for the second year and Ph.D. degrees increased for the eighth year in a row. The number of master's degrees was down 15% from 1986, and the number of Ph.D.s was up 15%. Projected 1988 numbers of master's and Ph.D. degrees in chemical engineering from these schools are up less than 1% for

Summary of totals from 1987 reports from approved schools

	Schools reporting	Men	Women	Total
CHEMISTRY				
Bachelors, Total	582	5581	3257	8838
Certified		2360	1303	3663
Noncertified		3221	1954	5175
Masters	316	1084	552	1636
Doctorates	186	1522	414	1936
CHEMICAL ENGINEERING				
Bachelors, Certified	107	3245	1190	4435
Masters	103	900	178	1078
Doctorates	90	487	46	533

master's degrees and up 32% for Ph.D.s.

The chemistry programs at ACS-approved schools normally are re-evaluated at five-year intervals. There were 584 colleges and universities on the approved list at the end of 1987. During the year, the committee studied the chemistry programs of 151 of the approved schools and of 28 schools applying

Summary of data from approved schools, 1983-87

	Bachelors				Masters		Doctorates	
	Number of schools	Graduates (total)	Certified graduates	Noncertified graduates	Number of schools	Graduates	Number of schools	Graduates
CHEMISTRY								
1983	570	10,043	4233	5810	320	1569	189	1759
1984	577	9,819	4201	5618	321	1637	189	1777
1985	579	9,679	4021	5658	316	1621	186	1806
1986	580	9,295	3892	5403	315	1620	187	1885
1987	582	8,838	3663	5175	316	1636	188	1936
CHEMICAL ENGINEERING ^a								
1983	122	7,021	7021	—	116	1317	101	333
1984	120	6,866	6866	—	114	1436	101	357
1985	123	6,442	6442	—	118	1489	104	418
1986	118	5,229	5229	—	116	1244	103	460
1987	107	4,435	4435	—	103	1078	90	533

^a Chemical engineering departments are not required to report their data to CPT, so the number of departments included in this category varies from year to year.

Committee members, 1987

Alice J. Cunningham, *chairman*
 Agnes Scott College
 Henry A. Bent
 North Carolina State University
 Norman G. Craig
 Oberlin College
 Marjorie C. Caserio
 University of California, Irvine
 Michael P. Doyle
 Trinity University
 C. David Gutsche
 Washington University
 Gordon A. Hamilton
 Pennsylvania State University
 Gordon G. Hammes
 Cornell University
 Herbert D. Keesz
 University of California, Los Angeles
 Karen W. Morse
 Utah State University
 Shalaby W. Shalaby
 Ethicon Inc.
 Richard P. Van Dyrne
 Northwestern University
 Barbara A. Gallagher, *committee secretary*
 Cathy A. Nelson, *staff associate*
 Dolphine S. Hite, *program assistant*
 American Chemical Society

were removed from probation; one continued on probation; and two were removed from the list.

With the endorsement of the Board of Directors, CPT proposed programs for optional certifiable chemistry degrees with emphasis in biochemistry, polymer chemistry, or chemistry education. In developing an extension to the 1983 guidelines for approved schools CPT consulted with the American Society of Biochemistry & Molecular Biology, Subcommittee A of the ACS Society Committee on Education, all interested ACS divisions, the ACS-approved schools, and the visiting associates of CPT. By year's end a final draft was being readied for distribution to all constituencies. The committee plans to begin the approval process for optional degree programs during the 1988-89 academic year.

The committee continued its development of a statistical database comprising information collected from five-year re-evaluation reports of ACS-approved schools. However, until the proposed extension of the guidelines is finally defined and suggested modifications in the five-year report form are completed, other nonstatistical sections of the five-year report will not be added to the database.

The ACS Committee on Chemistry & Public Affairs invited CPT to participate in an attempt to develop a long-range science policy, targeting certain areas such as education. CPT has endorsed this approach and

offered to provide guidance on any appropriate topics.

Hard copy of the ACS Directory of Graduate Research (DGR) continues to enjoy financial health. However, based on the latest economic factors, CPT voted to cancel the DGR on-line version. CPT is currently investigating the feasibility of converting the DGR concordance database to hard copy for possible inclusion in the directory.

CPT members met with representatives of the ACS marketing staff for a discussion of the educators' perspective of trends affecting the chemical community. The committee also met with a representative from the National Science Foundation's Office of Undergraduate Science, Engineering & Mathematics Education for a discussion of needs in curriculum directions and teaching materials. CPT will forward to NSF a statement of these needs as discerned by the committee.

Other CPT activities in 1987 included continued interaction with the ACS Society Committee on Education Task Force on ACS Involvement in the Two-Year Colleges; discussions with a representative of the Division of Chemical Education regarding the division's study of the content of a two-semester general chemistry course; endorsement of the Association of American Colleges inquiry into the nature and role of the undergraduate major in the arts and sciences; and representation at the National Research Council's colloquium on Calculus for a New Century.

The committee would like to acknowledge and thank the following visiting associates of the committee who conducted on-site visits to schools on the approved list or that are applying for ACS approval during 1987: John P. Chesick, Haverford College; Robert C. Fay, Cornell University; Frank A. Guthrie, Rose-Hulman Institute of Technology; Peter C. Jurs, Pennsylvania State University; William E. McEwen, University of Massachusetts; Brown L. Murr, Johns Hopkins University; William M. Risen Jr., Brown University; Amos B. Smith III, University of Pennsylvania; Wilmer Stratton, Earlham College; and Kenneth Williamson, Mount Holyoke College. □

for ACS approval. Each evaluation involved a review of extensive documentary materials submitted by the department chairmen describing the current status of the program.

Six schools were added to the ACS-approved list by CPT in 1987; one was put on probation; three

Graduate student enrollments in departments whose undergraduate chemistry programs are ACS approved

Number of departments	First-year graduate students		All graduate students	
	Full time	Part time	Full time	Part time
M.S. departments^a				
Fall 1983	132	452	293	1098
Fall 1984	131	468	270	1099
Fall 1985 ^b	129	417	292	1106
Fall 1986	128	474	264	1190
Ph.D. departments				
Fall 1983	189	3554	275	14,037
Fall 1984	186	3404	227	14,194
Fall 1985 ^b	187	3455	208	14,379
Fall 1986	187	3475	235	14,438

^a Departments whose highest offering is the master's degree in chemistry. ^b Corrected data from 1986 report.

Chemistry and chemical engineering degrees awarded by ACS-approved schools, 1986-87

	CHEMISTRY				CHEMICAL ENGINEERING					CHEMISTRY				CHEMICAL ENGINEERING			
	Bachelor's certified		M.S.	Ph.D.	B.S.	M.S.	Ph.D.	Bachelor's certified		M.S.	Ph.D.	B.S.	M.S.	Ph.D.			
	Yes	No						Yes							No		
Ablene Christian U	4	9	2	—	—	—	—	Santa Cruz	0	21	6	4	—	—	—		
Adelphi U	4	1	4	—	—	—	—	Calvin C	2	9	—	—	—	—	—		
Agnes Scott C	1	1	—	—	—	—	—	Canisius C	7	6	—	—	—	—	—		
Akron, U of	27	7	6	8	a	—	—	Capital U	1	2	—	—	—	—	—		
Alabama, U of								Carleton C	2	35	—	—	—	—	—		
Birmingham	1	9	4	1	—	—	—	Carnegie Mellon U	13	1	9	4	43	9	4		
Huntsville	3	4	5	—	a	—	—	Carroll C	2	5	—	—	—	—	—		
University	1	8	2	5	a	—	—	Carthage C	0	4	—	—	—	—	—		
Alaska, U of	1	0	4	—	—	—	—	Case Western Reserve U	4	31	8	15	39	8	3		
Albion C	2	10	—	—	—	—	—	Catholic U of America	6	0	2	5	a	—	—		
Albright C	5	13	—	—	—	—	—	Centenary C of Louisiana	0	3	—	—	—	—	—		
Alfred U	4	0	—	—	—	—	—	Central C	1	9	—	—	—	—	—		
Allegheny C	2	13	—	—	—	—	—	Central Connecticut State U	3	1	1	—	—	—	—		
Alma C	1	2	—	—	—	—	—	Central Florida, U of	15	0	4	—	—	—	—		
American U	2	1	6	5	—	—	—	Central Michigan U	0	16	2	—	—	—	—		
Amherst C	0	11	—	—	—	—	—	Central State U									
Andrews U	5	3	—	—	—	—	—	Ohio	0	2	—	—	—	—	—		
Appalachian State U	4	4	1	—	—	—	—	Oklahoma	2	7	—	—	—	—	—		
Arizona State U	22	5	4	8	a	—	—	Centre C	0	4	—	—	—	—	—		
Arizona, U of	17	28	9	10	22	9	1	Charleston, C of	7	10	—	—	—	—	—		
Arkansas, U of								Chatham C	6	0	—	—	—	—	—		
Fayetteville	8	14	2	11	41	15	5	Chestnut Hill C	1	5	—	—	—	—	—		
Little Rock	2	3	1	—	—	—	—	Chicago, U of	12	24	9	19	—	—	—		
Ashland C	1	7	—	—	—	—	—	Christian Brothers C ^b	—	—	—	—	a	—	—		
Auburn U	6	19	4	10	31	6	5	Cincinnati, U of	21	0	15	12	63	6	5		
Augsburg C	1	4	—	—	—	—	—	Citadel, The	1	2	—	—	—	—	—		
Augustana C								City U of New York									
Illinois	0	11	—	—	—	—	—	Graduate Center	—	—	—	11	—	—	—		
South Dakota	2	5	—	—	—	—	—	City C	2	9	3	—	a	—	—		
Austin C	1	4	—	—	—	—	—	Brooklyn C	1	29	5	—	—	—	—		
Baldwin-Wallace C	2	3	—	—	—	—	—	Herbert H. Lehman C	3	9	—	—	—	—	—		
Ball State U	6	4	5	—	—	—	—	Hunter C	0	14	0	2	—	—	—		
Barnard C	0	24	—	—	—	—	—	Queens C	2	15	7	—	—	—	—		
Bates C	4	12	—	—	—	—	—	Clarion U	4	1	—	—	—	—	—		
Baylor U	6	12	3	2	—	—	—	Clark U	10	0	2	8	—	—	—		
Beloit C	3	12	—	—	—	—	—	Clarkson U	7	10	2	2	78	18	5		
Bemidji State U	3	10	—	—	—	—	—	Clemson U	6	2	9	5	50	9	0		
Birmingham-Southern C	3	15	—	—	—	—	—	Cleveland State U	23	0	5	2	a	—	—		
Bloomsburg U	5	4	—	—	—	—	—	Coe C	0	7	—	—	—	—	—		
Boston C	12	8	8	4	—	—	—	Colby C	1	4	—	—	—	—	—		
Boston U	2	13	0	7	—	—	—	Colgate U	10	4	—	—	—	—	—		
Bowdoin C	0	40	—	—	—	—	—	Colorado C	7	7	—	—	—	—	—		
Bowling Green State U	5	9	3	—	—	—	—	Colorado School of Mines	4	0	8	8	55	11	3		
Bradley U	5	6	0	—	—	—	—	Colorado State U	11	17	0	18	21	6	1		
Brandeis U	0	8	2	9	—	—	—	Colorado, U of									
Bridgeport, U of	1	0	7	—	—	—	—	Boulder	4	42	6	15	45	12	5		
Bridgewater State C	1	7	2	—	—	—	—	Colorado Springs	3	5	—	—	—	—	—		
Brigham Young U	14	20	6	7	44	6	5	Denver	2	8	4	—	—	—	—		
Brown U	0	20	6	17	4	2	0	Columbia U	10	6	16	23	22	25	8		
Bryn Mawr C	20	0	3	3	—	—	—	Concordia C	0	13	—	—	—	—	—		
Bucknell U	4	14	3	—	20	6	—	Connecticut, U of	20	12	3	14	25	10	1		
Butler U	2	9	4	—	—	—	—	Cooper Union ^b	—	—	—	—	17	—	—		
California Institute of Tech	16	0	1	30	5	10	17	Cornell C	1	5	—	—	—	—	—		
California Polytechnic State U	15	38	1	—	—	—	—	Cornell U	20	41	36	27	33	4	12		
California State C,								Creighton U	0	18	2	—	—	—	—		
Bakersfield	6	1	—	—	—	—	—	Dartmouth C	0	28	1	6	—	—	—		
California State Polytechnic U	12	6	3	—	a	—	—	David Lipscomb C	2	11	—	—	—	—	—		
Chico	0	11	—	—	—	—	—	Davidson C	4	2	—	—	—	—	—		
Dominguez Hills	2	3	—	—	—	—	—	Dayton, U of	8	9	—	—	29	6	—		
Fresno	8	7	5	—	—	—	—	DePaul U	1	7	4	—	—	—	—		
Fullerton	7	16	3	—	—	—	—	DePaul U	3	13	—	—	—	—	—		
Hayward	11	6	3	—	—	—	—	Delaware State C	2	2	0	—	—	—	—		
Long Beach	13	26	5	—	44	—	—	Delaware, U of	40	25	7	8	41	5	14		
Los Angeles	12	0	3	—	—	—	—	Delaware Valley C of									
Northridge	12	16	2	—	—	—	—	Science & Agriculture	5	0	—	—	—	—	—		
Sacramento	18	7	6	—	—	—	—	Delta State U	1	17	—	—	—	—	—		
San Bernardino	0	5	—	—	—	—	—	Denison U	3	4	—	—	—	—	—		
Stanislaus	2	1	—	—	—	—	—	Denver, U of	4	17	2	0	—	—	—		
California, U of								Detroit, U of	5	7	5	2	a	—	—		
Berkeley	51	0	13	53	87	8	27	Dickinson C	1	8	—	—	—	—	—		
Davis	21	17	1	17	28	3	1	Drake U	3	4	—	—	—	—	—		
Irvine	14	40	8	12	—	—	—	Drew U	2	6	—	—	—	—	—		
Los Angeles	25	54	7	22	14	5	2	Drexel U	6	0	13	5	59	11	1		
Riverside	7	1	6	7	—	—	—	Duke U	9	39	0	15	—	—	—		
San Diego	57	0	22	33	26	6	4	Duquesne U	1	3	5	0	—	—	—		
Santa Barbara	16	16	8	9	29	8	4	Earlham C	1	0	—	—	—	—	—		

	CHEMISTRY				CHEMICAL ENGINEERING					CHEMISTRY				CHEMICAL ENGINEERING			
	Bachelor's certified		M.S.	Ph.D.	B.S.	M.S.	Ph.D.	Bachelor's certified		M.S.	Ph.D.	B.S.	M.S.	Ph.D.			
	Yes	No						Yes							No		
East Carolina U	8	3	0	—	—	—	—	Iowa, U of	16	0	12	17	21	6	2		
East Stroudsburg U	4	5	1	—	—	—	—	Ithaca C	9	0	—	—	—	—	—		
East Tennessee State U	9	6	2	—	—	—	—	Jackson State U	3	4	3	—	—	—	—		
East Texas State U	0	3	1	—	—	—	—	James Madison U	5	11	—	—	—	—	—		
Eastern Illinois U	1	9	8	—	—	—	—	John Carroll C	3	11	2	—	—	—	—		
Eastern Kentucky U	5	13	2	—	—	—	—	Johns Hopkins U	15	0	13	12	17	6	1		
Eastern Michigan U	11	18	7	—	—	—	—	Junata C	10	10	—	—	—	—	—		
Eastern New Mexico U	1	4	1	—	—	—	—	Kalamazoo C	1	14	—	—	—	—	—		
Eckerd C	1	1	—	—	—	—	—	Kansas State U	7	11	6	11	13	8	1		
Elizabethtown C	3	15	—	—	—	—	—	Kansas, U of	14	19	3	4	26	5	1		
Elmhurst C	2	13	—	—	—	—	—	Kean C of New Jersey	9	7	—	—	—	—	—		
Emory U	2	28	2	15	—	—	—	Kearney State C	0	11	—	—	—	—	—		
Emporia State U	4	4	2	—	—	—	—	Kent State U	15	8	0	3	—	—	—		
Evansville, U of	4	6	—	—	—	—	—	Kentucky, U of	8	14	9	4	26	14	2		
Fairfield U	3	2	—	—	—	—	—	Kenyon C	3	12	—	—	—	—	—		
Fairleigh Dickinson U								King's C	3	3	—	—	—	—	—		
Madison	6	0	0	—	—	—	—	Knox C	2	8	—	—	—	—	—		
Teaneck	9	7	4	—	—	—	—	La Salle U	5	3	—	—	—	—	—		
Fisk U	7	0	1	—	—	—	—	Lafayette C	6	6	—	—	21	—	—		
Florida Atlantic U	6	16	1	—	—	—	—	Lake Forest C	1	10	—	—	—	—	—		
Florida Institute of Tech	0	1	1	—	17	3	—	Lamar U	7	1	4	—	23	8	3		
Florida International U	5	6	—	—	—	—	—	Lawrence Institute of Tech	18	0	—	—	—	—	—		
Florida State U	4	18	6	11	—	—	—	Lawrence U ^c	4	2	10	4	—	—	—		
Florida, U of	3	28	2	26	52	5	5	Le Moyne C	10	0	—	—	—	—	—		
Fordham U	0	13	5	—	—	—	—	Lebanon Valley C	4	4	—	—	—	—	—		
Fort Lewis C	4	16	—	—	—	—	—	Lehigh U	7	6	11	10	37	19	10		
Franklin & Marshall C	8	12	—	—	—	—	—	Lewis & Clark C	0	8	—	—	—	—	—		
Furman U	11	6	1	—	—	—	—	Lincoln U	2	5	—	—	—	—	—		
Geneva C	2	7	—	—	—	—	—	Long Island U									
George Mason U	5	0	—	—	—	—	—	Brooklyn Campus	3	1	6	—	—	—	—		
George Washington U	2	7	0	3	—	—	—	C. W. Post C	2	0	—	—	—	—	—		
Georgetown U	19	0	6	7	—	—	—	Loras C	2	8	—	—	—	—	—		
Georgia Institute of Tech	15	0	2	11	91	21	5	Louisiana State U									
Georgia State U	2	5	1	—	—	—	—	Baton Rouge	7	5	4	14	38	11	3		
Georgia, U of	2	17	3	12	—	—	—	Shreveport	5	0	—	—	—	—	—		
Gettysburg C	4	5	—	—	—	—	—	Louisiana Tech U	4	3	3	—	21	4	1		
Glassboro State C	6	0	—	—	—	—	—	Louisville, U of	5	20	4	4	31	21	1		
Gonzaga U	2	1	—	—	—	—	—	Lowell, U of	2	1	9	12	27	3	—		
Goucher C	1	2	—	—	—	—	—	Loyola C	1	4	—	—	—	—	—		
Grand Valley State C	0	6	—	—	—	—	—	Loyola Marymount U	3	0	—	—	—	—	—		
Grinnell C	3	21	—	—	—	—	—	Loyola U									
Gustavus Adolphus C	3	11	—	—	—	—	—	Chicago	9	12	4	2	—	—	—		
Hamilton C	0	3	—	—	—	—	—	New Orleans	0	5	—	—	—	—	—		
Hamline U	4	2	—	—	—	—	—	Luther C	0	4	—	—	—	—	—		
Hampden-Sydney C	5	2	—	—	—	—	—	Macalester C	2	8	—	—	—	—	—		
Hampton U	2	0	1	—	—	—	—	Maine, U of, at Orono	3	3	1	2	32	6	2		
Hartford, U of	2	0	0	—	—	—	—	Manhattan C ^d	4	4	—	—	a	—	—		
Hartwick C	2	0	—	—	—	—	—	Manhattanville C	1	1	—	—	—	—	—		
Harvard U	0	22	21	13	—	—	—	Mankato State U	8	17	2	—	—	—	—		
Harvey Mudd C	12	0	—	—	—	—	—	Marietta C	1	1	—	—	—	—	—		
Haverford C	19	1	—	—	—	—	—	Marist C	1	0	—	—	—	—	—		
Hawaii, U of	16	3	6	6	—	—	—	Marquette U	13	0	2	1	—	—	—		
Hiram C	4	2	—	—	—	—	—	Marshall U	2	26	3	—	—	—	—		
Hobart & William Smith C	0	4	—	—	—	—	—	Maryland, U of									
Hofstra U	3	5	—	—	—	—	—	Baltimore County	16	20	1	1	—	—	—		
Hollins C	0	2	—	—	—	—	—	College Park	17	52	10	21	a	—	—		
Holy Cross, C of The	29	5	—	—	—	—	—	Massachusetts Institute of									
Hope C	9	14	—	—	—	—	—	Tech	39	0	5	37	63	42	21		
Houston, U	10	1	8	18	35	46	7	Massachusetts, U of	15	7	7	21	24	6	10		
Howard U	1	21	3	2	23	3	—	McNeese State U	3	0	0	—	—	—	—		
Humboldt State U	0	6	—	—	—	—	—	Memphis State U	6	7	3	0	—	—	—		
Idaho State U	6	1	3	—	—	—	—	Mercer U	2	5	—	—	—	—	—		
Idaho, U of	4	8	2	4	17	6	1	Merrimack C	4	1	—	—	—	—	—		
Illinois Benedictine C	12	0	—	—	—	—	—	Metropolitan State C	7	19	—	—	—	—	—		
Illinois Institute of Tech	4	0	3	2	30	9	7	Miami U	14	38	5	3	—	—	—		
Illinois State U	38	0	16	—	—	—	—	Miami, U of	1	48	3	2	—	—	—		
Illinois, U of								Michigan State U	17	21	7	28	50	3	1		
Chicago	19	16	17	13	42	22	6	Michigan Tech U	14	0	5	0	56	10	—		
Urbana-Champaign	59	65	11	47	64	18	18	Michigan, U of									
Illinois Wesleyan U	5	2	—	—	—	—	—	Ann Arbor	60	0	22	18	62	10	8		
Indiana State U	7	0	1	—	—	—	—	Dearborn	7	6	—	—	—	—	—		
Indiana U	23	105	11	26	—	—	—	Flint	4	6	—	—	—	—	—		
Indiana U of Pennsylvania	8	9	1	—	—	—	—	Middle Tennessee State U	3	15	2	1	—	—	—		
Indiana U at South Bend	6	3	—	—	—	—	—	Middlebury C	0	3	0	—	—	—	—		
Indiana U Northwest	0	3	—	—	—	—	—	Midwestern State U	4	2	—	—	—	—	—		
Indiana U-Purdue U								Millersville U	9	14	—	—	—	—	—		
Fort Wayne	2	6	—	—	—	—	—	Millsaps C	5	11	—	—	—	—	—		
Indianapolis	1	24	15	—	—	—	—	Minnesota, U of									
Interamerican U of								Duluth	8	6	8	—	—	—	—		
Puerto Rico	0	6	—	—	—	—	—	Minneapolis	32	0	8	21	92	9	23		
Iowa State U	16	5	6	34	57	12	11	Mississippi C	0	8	—	—	—	—	—		

	CHEMISTRY				CHEMICAL ENGINEERING					CHEMISTRY				CHEMICAL ENGINEERING			
	Bachelor's certified		M.S.	Ph.D.	B.S.	M.S.	Ph.D.	Bachelor's certified		M.S.	Ph.D.	B.S.	M.S.	Ph.D.			
	Yes	No						Yes							No		
Mississippi State U	5	5	2	1	53	12	0	Oregon, U of	0	25	2	5	—	—	—		
Mississippi, U of	0	7	1	1	15	5	1	Pace U, New York	2	2	—	—	—	—	—		
Missouri, U of								Pacific Lutheran U	2	7	—	—	—	—	—		
Columbia	10	8	10	4	26	5	3	Pacific, U of The	0	7	0	0	—	—	—		
Kansas City	9	14	2	6	—	—	—	Pennsylvania State U	6	8	10	29	115	12	6		
Rolla	13	0	6	5	69	15	7	Pennsylvania, U of	6	18	4	25	26	9	12		
St. Louis	6	15	11	2	—	—	—	Philadelphia C of									
Missouri Western State C	9	0	—	—	—	—	—	Pharmacy & Science	11	0	2	0	—	—	—		
Monmouth C								Philadelphia C of									
Illinois	1	2	—	—	—	—	—	Textiles & Sciences	6	0	—	—	—	—	—		
New Jersey	3	1	—	—	—	—	—	Pittsburg State U	3	6	0	—	—	—	—		
Montana C of Mineral								Pittsburgh, U of	22	48	8	24	72	17	8		
Science & Technology	2	4	1	—	—	—	—	Polytechnic U	1	0	10	5	19	6	4		
Montana State U	2	9	4	4	a	—	—	Pomona C	3	4	—	—	—	—	—		
Montana, U of	6	6	3	2	—	—	—	Portland State U	7	2	1	1	—	—	—		
Montclair State C	2	17	3	—	—	—	—	Pratt Institute ^b	—	—	—	—	a	—	—		
Moorhead State U	4	3	—	—	—	—	—	Princeton U	22	10	21	21	23	1	8		
Moravian C	1	2	—	—	—	—	—	Providence C	2	3	0	0	—	—	—		
Morehouse C ^a	3	1	—	—	—	—	—	Puerto Rico, U of									
Morgan State U	5	5	—	—	—	—	—	Mayaguez	12	8	4	—	43	1	—		
Mount Holyoke C	0	14	1	1	—	—	—	Rio Piedras	3	40	7	9	—	—	—		
Mount Saint Vincent, C of ^d	0	3	—	—	—	—	—	Puget Sound, U of	5	2	—	—	—	—	—		
Muhlenberg C	1	12	—	—	—	—	—	Purdue U	45	15	8	41	122	15	10		
Murray State U	1	13	3	—	—	—	—	Purdue U Calumet	2	1	—	—	—	—	—		
Muskingum C	5	6	—	—	—	—	—	Ramapo C of New Jersey	1	8	—	—	—	—	—		
Nebraska, U of								Randolph-Macon Woman's C	0	4	—	—	—	—	—		
Lincoln	5	14	5	12	23	7	—	Redlands, U of	0	1	—	—	—	—	—		
Omaha	4	1	—	—	—	—	—	Reed C	14	7	—	—	—	—	—		
Nebraska Wesleyan U	4	2	—	—	—	—	—	Rensselaer Polytechnic Institute	24	0	12	15	47	11	11		
Nevada, U of								Rhode Island C	2	0	—	—	—	—	—		
Las Vegas	0	15	0	—	—	—	—	Rhode Island, U of	1	2	4	4	17	7	1		
Reno	1	1	1	3	—	—	—	Rhodes C	6	2	—	—	—	—	—		
New Hampshire, U of	12	8	8	3	19	6	0	Rice U	4	11	16	13	19	3	17		
New Jersey Institute of Tech ^b	—	—	—	—	57	17	2	Richmond, U of	4	9	0	—	—	—	—		
New Mexico Highlands U	0	0	0	—	—	—	—	Rider C	0	0	—	—	—	—	—		
New Mexico Institute of								Ripon C	4	2	—	—	—	—	—		
Mines & Tech	6	0	3	—	—	—	—	Roanoke C	4	2	—	—	—	—	—		
New Mexico State U	6	15	2	6	37	2	2	Rochester Institute of Tech	7	10	6	—	—	—	—		
New Mexico, U of	9	2	10	9	14	6	1	Rochester, U of	4	7	28	16	27	6	3		
New Orleans, U of	2	4	5	5	—	—	—	Rollins C	1	1	—	—	—	—	—		
New York U	3	50	24	12	—	—	—	Roosevelt U	3	1	4	—	—	—	—		
Niagara U	1	7	—	—	—	—	—	Rose-Hulman Institute of Tech	6	0	—	—	41	3	—		
North Alabama, U of	5	8	—	—	—	—	—	Russell Sage C	1	3	—	—	—	—	—		
North Carolina A&T State U	6	0	6	—	—	—	—	Rutgers U									
North Carolina Central U	1	7	3	—	—	—	—	Camden C	1	11	—	—	—	—	—		
North Carolina State U	26	20	8	12	91	5	4	Newark C of Arts & Sciences	11	10	5	4	—	—	—		
North Carolina, U of								New Brunswick	23	61	19	16	40	13	4		
Asheville	2	1	—	—	—	—	—	Saginaw Valley State C	1	10	—	—	—	—	—		
Chapel Hill	37	44	15	31	—	—	—	St. Anselm C	0	4	—	—	—	—	—		
Charlotte	3	9	1	—	—	—	—	St. Catherine, C of	5	3	—	—	—	—	—		
Greensboro	6	6	3	—	—	—	—	St. Cloud State U	6	18	—	—	—	—	—		
Wilmington	4	11	—	—	—	—	—	St. John Fisher C	6	0	—	—	—	—	—		
North Dakota State U	1	16	2	7	—	—	—	St. John's U/C of St. Benedict	5	13	—	—	—	—	—		
North Dakota, U of	6	5	1	2	28	7	—	St. John's U	8	0	5	—	—	—	—		
North Texas State U	4	4	6	7	—	—	—	St. Joseph C	4	1	6	—	—	—	—		
Northeast Louisiana U	4	1	5	—	—	—	—	St. Joseph's U	3	15	1	—	—	—	—		
Northeast Missouri State U	0	10	—	—	—	—	—	St. Lawrence U	1	19	—	—	—	—	—		
Northeastern Illinois U	2	9	2	—	—	—	—	St. Louis U	5	8	7	—	—	—	—		
Northeastern U	4	0	6	10	a	—	—	St. Mary's C	3	7	—	—	—	—	—		
Northern Arizona U	4	19	2	—	—	—	—	St. Michael's C	2	0	—	—	—	—	—		
Northern Colorado, U of	9	0	3	0	—	—	—	St. Olaf C	6	39	—	—	—	—	—		
Northern Illinois U	5	14	4	4	—	—	—	St. Peter's C	2	0	—	—	—	—	—		
Northern Iowa, U of	7	11	0	—	—	—	—	St. Thomas, C of	3	4	—	—	—	—	—		
Northern Kentucky U	2	5	—	—	—	—	—	Salem State C	3	0	—	—	—	—	—		
Northern Michigan U	0	5	0	—	—	—	—	Sam Houston State U	4	1	2	—	—	—	—		
Northwest Missouri State U	4	2	—	—	—	—	—	San Diego State U	19	2	10	4	—	—	—		
Northwestern State U of								San Francisco State U	4	29	7	—	—	—	—		
Louisiana	0	1	—	—	—	—	—	San Francisco, U of	2	3	3	—	—	—	—		
Northwestern U	6	14	30	28	31	23	9	San Jose State U	22	17	6	—	a	—	—		
Noire Dame, U	1	11	8	11	35	6	4	Sangamon State U	3	1	—	—	—	—	—		
Oakland U	5	6	1	—	—	—	—	Santa Clara, U of	2	3	—	—	—	—	—		
Oberlin C	0	13	—	—	—	—	—	Scranton, U of	8	13	9	—	—	—	—		
Occidental C	3	16	—	—	—	—	—	Seattle U	3	3	—	—	—	—	—		
Ohio Northern U	2	3	—	—	—	—	—	Seton Hall U	8	9	10	3	—	—	—		
Ohio State U	42	0	17	28	55	11	11	Shippensburg U	7	3	1	—	—	—	—		
Ohio U	4	11	6	8	8	7	1	Siena C	6	0	—	—	—	—	—		
Ohio Wesleyan U	1	4	—	—	—	—	—	Simmons C	2	3	—	—	—	—	—		
Oklahoma State U	2	1	8	11	38	15	4	Skidmore C	0	19	—	—	—	—	—		
Oklahoma, U of	4	17	7	7	30	10	3	Smith C	3	2	0	0	—	—	—		
Old Dominion U	8	2	3	—	—	—	—	Sonoma State U	3	8	—	—	—	—	—		
Oregon State U	7	0	8	12	51	9	2	South Alabama, U of ^b	—	—	—	—	a	—	—		

	CHEMISTRY				CHEMICAL ENGINEERING					CHEMISTRY				CHEMICAL ENGINEERING				
	Bachelor's certified		M.S.	Ph.D.	B.S.		M.S.	Ph.D.		Bachelor's certified		M.S.	Ph.D.	B.S.		M.S.	Ph.D.	
	Yes	No								Yes	No							
South Carolina, U of	2	13	5	24	30	7	2	Utah State U	10	0	3	7	—	—	—	—	—	—
South Dakota School of Mines & Tech	7	0	2	—	31	2	—	Utah, U of	4	23	3	13	a	—	—	—	—	
South Dakota State U	2	24	7	—	—	—	—	Valparaiso U	7	24	—	—	—	—	—	—	—	
South Dakota, U of	2	11	2	—	—	—	—	Vanderbilt U	1	12	2	10	21	2	0	—	—	
South Florida, U of	10	33	3	5	26	4	1	Vassar C	0	6	1	—	—	—	—	—	—	
Southeast Missouri State U	2	7	—	—	—	—	—	Vermont, U of	12	0	1	8	—	—	—	—	—	
Southeastern Louisiana U	4	0	—	—	—	—	—	Villanova U	4	0	12	8	25	8	—	—	—	
Southeastern Massachusetts U	4	7	4	—	—	—	—	Virginia Commonwealth U	9	19	2	4	—	—	—	—	—	
Southern California, U of	13	2	2	9	27	10	3	Virginia Military Institute	1	0	—	—	—	—	—	—	—	
Southern Colorado U	3	3	—	—	—	—	—	Virginia Polytechnic Institute & State U	17	13	11	13	44	10	6	—	—	
Southern Illinois U								Virginia, U of	11	90	7	15	18	32	2	—	—	
Carbondale	10	6	8	3	—	—	—	Wabash C	5	4	—	—	—	—	—	—	—	
Edwardsville	8	2	6	—	—	—	—	Wagner C	3	4	—	—	—	—	—	—	—	
Southern Methodist U	5	6	0	—	—	—	—	Wake Forest U	0	21	0	1	—	—	—	—	—	
Southern Mississippi, U of	1	16	2	4	—	—	—	Washburn U of Topeka	3	3	—	—	—	—	—	—	—	
Southern Oregon State C	4	2	—	—	—	—	—	Washington C	5	0	—	—	—	—	—	—	—	
Southern U and A&M C	7	0	3	—	—	—	—	Washington State U	6	6	3	6	34	7	1	—	—	
Southwest Missouri State U	7	17	—	—	—	—	—	Washington U	0	12	11	7	28	13	5	—	—	
Southwest State U	2	5	—	—	—	—	—	Washington, U of	37	17	10	18	67	16	10	—	—	
Southwest Texas State U	9	0	0	—	—	—	—	Washington & Jefferson C	1	19	—	—	—	—	—	—	—	
Southwestern Louisiana, U of	0	15	5	—	a	—	—	Washington & Lee U	0	15	—	—	—	—	—	—	—	
Southwestern Oklahoma State U	1	4	—	—	—	—	—	Wayne State U	21	34	7	20	36	5	1	—	—	
Stanford U	5	11	1	25	11	12	7	Waynesburg C	2	2	—	—	—	—	—	—	—	
State U of New York								Weber State C	9	6	—	—	—	—	—	—	—	
Albany	19	7	5	11	—	—	—	Wellesley C	5	23	—	—	—	—	—	—	—	
Binghamton	12	17	7	7	—	—	—	Wesleyan U	4	9	0	5	—	—	—	—	—	
Buffalo	21	12	6	16	50	6	6	West Chester U	3	18	6	—	—	—	—	—	—	
Stony Brook	23	37	2	13	—	—	—	West Florida, U of	5	1	—	—	—	—	—	—	—	
C at Brockport	5	6	—	—	—	—	—	West Texas State U	0	12	2	—	—	—	—	—	—	
C at Buffalo	7	5	1	—	—	—	—	West Virginia Institute of Tech ^b	—	—	—	—	18	6	—	—	—	
C at Cortland	1	0	—	—	—	—	—	West Virginia State C	2	5	—	—	—	—	—	—	—	
C at Fredonia	15	4	1	—	—	—	—	West Virginia U	12	45	4	1	35	6	4	—	—	
C at Genesee	9	1	—	—	—	—	—	Western Illinois U	1	3	8	—	—	—	—	—	—	
C at New Paltz	3	5	1	—	—	—	—	Western Kentucky U	0	14	3	—	—	—	—	—	—	
C at Oneonta	2	9	0	—	—	—	—	Western Maryland C	1	4	—	—	—	—	—	—	—	
C at Oswego	10	5	2	—	—	—	—	Western Michigan U	3	26	5	1	—	—	—	—	—	
C at Plattsburgh	6	13	0	—	—	—	—	Western New England C	2	0	—	—	—	—	—	—	—	
C at Potsdam	1	15	—	—	—	—	—	Western Washington U	8	19	0	—	—	—	—	—	—	
Stephen F. Austin State U	6	2	2	—	—	—	—	Westminster C	0	4	—	—	—	—	—	—	—	
Stetson U	3	3	—	—	—	—	—	Wheaton C					—	—	—	—	—	
Stevens Institute of Tech	3	4	12	1	12	12	5	Illinois	2	7	—	—	—	—	—	—	—	
Stockton State C	1	13	—	—	—	—	—	Massachusetts	0	7	—	—	—	—	—	—	—	
Suffolk U	0	2	—	—	—	—	—	Wheeling C	1	8	—	—	—	—	—	—	—	
Susquehanna U	2	2	—	—	—	—	—	Whitman C	3	4	—	—	—	—	—	—	—	
Swarthmore C	4	8	—	—	—	—	—	Whittier C	1	7	—	—	—	—	—	—	—	
Syracuse U	13	5	6	6	a	—	—	Wichita State U	5	9	4	2	—	—	—	—	—	
Temple U	13	6	3	5	—	—	—	Widener U	1	3	—	—	12	0	—	—	—	
Tennessee Tech U	3	6	2	—	a	—	—	Wilkes C	2	1	—	—	—	—	—	—	—	
Tennessee, U of								Willamette U	0	7	—	—	—	—	—	—	—	
Knoxville	3	13	7	9	55	10	0	William Paterson C of N.J.	0	4	—	—	—	—	—	—	—	
Martin	5	9	—	—	—	—	—	William & Mary, C of	22	10	5	—	—	—	—	—	—	
Chattanooga	11	16	—	—	—	—	—	Williams C	0	23	—	—	—	—	—	—	—	
Texas A&I U	8	0	2	—	a	—	—	Wisconsin, U of					—	—	—	—	—	
Texas A&M U	10	14	14	24	89	11	7	Eau Claire	6	6	—	—	—	—	—	—	—	
Texas Christian U	3	14	2	1	—	—	—	Green Bay	0	6	—	—	—	—	—	—	—	
Texas Southern U	4	0	7	—	—	—	—	La Crosse	4	8	—	—	—	—	—	—	—	
Texas Tech U	13	4	6	10	24	5	1	Madison	37	6	14	47	97	7	12	—	—	
Texas, U of								Milwaukee	3	18	12	5	—	—	—	—	—	
Arlington	8	10	5	1	—	—	—	Oshkosh	2	5	—	—	—	—	—	—	—	
Austin	66	0	5	27	95	11	19	Parkside	2	6	—	—	—	—	—	—	—	
Dallas	7	0	6	—	—	—	—	Platteville	0	2	—	—	—	—	—	—	—	
El Paso	9	0	6	—	—	—	—	River Falls	9	7	—	—	—	—	—	—	—	
Texas Woman's U	1	5	0	1	—	—	—	Stevens Point	5	19	—	—	—	—	—	—	—	
Thiel C	0	4	—	—	—	—	—	Superior	3	6	—	—	—	—	—	—	—	
Thomas More C	1	0	—	—	—	—	—	Wittenberg U	3	10	—	—	—	—	—	—	—	
Toledo, U of	9	9	4	2	23	12	1	Wooster, C of	2	27	—	—	—	—	—	—	—	
Towson State U	0	7	—	—	—	—	—	Worcester Polytechnic Institute	3	4	1	0	28	8	2	—	—	
Trenton State C	11	0	—	—	—	—	—	Wright State U	12	5	12	—	—	—	—	—	—	
Trinity C	7	6	0	—	—	—	—	Wyoming, U of	2	3	3	4	9	6	1	—	—	
Trinity U	2	4	—	—	—	—	—	Xavier U of Louisiana	0	49	—	—	—	—	—	—	—	
Tri-State U ^b	—	—	—	—	15	—	—	Xavier U	2	2	—	—	—	—	—	—	—	
Tufts U	0	9	6	2	a	—	—	Yale U	11	0	32	24	3	3	7	—	—	
Tulane U of Louisiana	0	4	1	1	12	5	6	Youngstown State U	12	37	0	—	19	0	0	—	—	
Tulsa, U of	3	0	—	—	13	8	3	TOTALS	3663	5175	1636	1936	4435	1078	533	—	—	
Tuskegee U	0	5	2	—	14	—	—											
Union C	3	14	—	—	—	—	—											
U.S. Air Force Academy	10	3	—	—	—	—	—											
U.S. Naval Academy	15	1	—	—	—	—	—											
Ursinus C	2	10	—	—	—	—	—											

Note: For brevity, "B.S." and "M.S." are used to denote all bachelor's and master's degrees respectively, in each column. a Data not submitted. b Listed on basis of accreditation by AICHE-ABET. c Master's and Ph.D. degrees given by the Institute of Paper Chemistry. d The chemistry programs at Mount Saint Vincent and Manhattan College are integrated into combined department with all instruction in chemistry located at Manhattan College. Master's and Ph.D. degrees given by Atlanta University.

Berkeley again top Ph.D. producer

For the third year in a row the University of California, Berkeley, has graduated more Ph.D. chemists than any other campus in the U.S. Also for the third year in a row, Indiana University has produced the most chemistry graduates at the bachelor level.

For the past 14 years either Berkeley, six times, or the University of Illinois, Urbana-Champaign, eight times, has been the largest producer of Ph.D. chemists. In the latest year, 1986-87, Urbana-Champaign moves back into the second spot after slipping to seventh the previous year.

At the bachelor's level, Urbana-Champaign was the second largest producer in 1986-87, up from third the previous year, and the University of Virginia moved up into third place from fifth.

These are some of the data that can be gleaned from the latest annual report of ACS's Committee on Professional Training (see page 49). This committee sets standards for chemistry undergraduate programs and monitors them. It also collects data annually on the number of chemistry graduates, at the bachelor's, master's, and doctoral levels, from all departments with bachelor programs it approves.

The latest report indicates that the University of Texas, Austin, moved up from seventh place the year before to become the largest producer of new chemists with undergraduate degrees certified by ACS in 1986-87, replacing Urbana-Champaign, which slipped to third. The University of Michigan, Ann Arbor, took second place, up from third.

Cornell University retained its position as the leading producer of new master's chemists. Yale moved up to second, from fifth. And Northwestern University held on to the third spot.

Purdue was the largest producer of bachelor chemical engineers in 1986-87, with 122. Second was the University of Pennsylvania with 115.

Michael Heylin

These schools had the most chemistry graduates, 1986-87

Total bachelor graduates

1. Indiana U	128
2. U of Illinois, Urbana-Champaign	124
3. U of Virginia	101
4. Rutgers U, New Brunswick	84
5. U of North Carolina, Chapel Hill	81
6. U of California, Los Angeles	79
7. U of Pittsburgh	70
8. U of Maryland, College Park	69
9. U of Texas, Austin	66
10. U of Delaware	65
11. Cornell U	61
12. U of Michigan, Ann Arbor	60
12. Purdue U	60
12. State U of New York, Stony Brook	60
15. U of California, San Diego	57
15. West Virginia U	57
17. Wayne State U	55
18. U of California, Irvine	54
18. U of Washington	54
20. California Polytechnic State U	53
21. Miami U	52
21. New York U	52
23. U of California, Berkeley	51
24. U of Miami	49
24. Xavier U of Louisiana	49

Certified bachelor graduates

1. U of Texas, Austin	66
2. U of Michigan, Ann Arbor	60
3. U of Illinois, Urbana-Champaign	59
4. U of California, San Diego	57
5. U of California, Berkeley	51
6. Purdue U	45
7. Ohio State U	42
8. U of Delaware	40
9. Massachusetts Inst of Tech	39
10. Illinois State U	38
11. U of North Carolina, Chapel Hill	37
11. U of Washington	37
11. U of Wisconsin, Madison	37
14. U of Minnesota, Minneapolis	32
15. C of The Holy Cross	29
16. U of Akron	27
17. North Carolina State U	28
18. U of California, Los Angeles	25
19. Rensselaer Polytechnic Institute	24
20. Cleveland State U	23
20. Indiana U	23
20. State U of New York, Stony Brook	23
20. Rutgers U, New Brunswick	23
24. Arizona State U	22
24. U of Pittsburgh	22
24. Princeton U	22
24. San Jose State U	22
24. C of William & Mary	22

Masters graduates

1. Cornell U	36
2. Yale U	32
3. Northwestern U	30
4. U of Rochester	29
5. New York U	24
6. U of California, San Diego	22
6. U of Michigan, Ann Arbor	22
8. Harvard U	21
8. Princeton U	21
10. Rutgers U, New Brunswick	19
11. U of Illinois, Chicago	17
11. Ohio State U	17
13. Columbia U	16
13. Illinois State U	16
13. Rice U	16
16. U of Cincinnati	15
16. Indiana/Purdue U, Indianapolis	15
18. Texas A&M U	14
18. U of Wisconsin, Madison	14
20. U of California, Berkeley	13
20. Drexel U	13
20. Johns Hopkins U	13
23. U of Iowa	12
23. Rensselaer Polytechnic Institute	12
23. Stevens Institute of Technology	12
23. U of Wisconsin, Milwaukee	12
23. Villanova U	12
23. Wright State U	12

Doctoral graduates

1. U of California, Berkeley	63
2. U of Illinois, Urbana-Champaign	47
2. U of Wisconsin, Madison	47
4. Purdue U	41
5. Massachusetts Inst of Tech	37
6. Iowa State U	34
7. U of California, San Diego	33
8. U of North Carolina, Chapel Hill	31
9. California Inst of Tech	30
10. Pennsylvania State U	29
11. Michigan State U	28
11. Northwestern U	28
11. Ohio State U	28
14. Cornell U	27
14. U of Texas, Austin	27
16. U of Florida	26
16. Indiana U	26
18. U of Pennsylvania	25
18. Stanford U	26
20. U of Pittsburgh	24
20. U of South Carolina	24
20. Texas A&M U	24
20. Yale U	24
24. Columbia U	23
25. U of California, Los Angeles	22